WMU’s President, Dr. Edward Montgomery, driving the Bronco Baja vehicle in front of The College of Engineering and Applied Sciences.
Welcome to this issue of the Mechanical and Aerospace Engineering Department (MAE) newsletter where we highlight the latest department happenings. The MAE department enjoys the largest enrollment within the College of Engineering and Applied Sciences (CEAS). Our faculty continue to expand their research into new areas. Our graduates continue to enjoy a very high rate of post-graduation employment with competitive salaries.

There are some new faces in the MAE office. This summer, Cristine Thomas was promoted to the rank of Administrative Assistant II and took the place of Amanda Hoger who transferred to another department at WMU. Cristine joined WMU and the MAE department in January 2019 and has experience working in aviation and bookstore management. Tamara (Tammy) Webb was hired to take Cristine’s former position. Tammy comes to us with 27 years of owning her own practice as a medical transcriptionist.

This fall, we awarded the department Alumni Excellence Award to Gerard DeVito, retired Vice President of Technology, Vehicle Group, at Eaton (B.S. Mechanical Engineering ’88) and Erik Pederson, Vice President and General Manager for Woodward Turbine Combustion Systems in Zeeland, Michigan (B.S. Aeronautical Engineering ’99, M.S. Mechanical Engineering ’01, Ph.D. Mechanical Engineering ’03). You can read more about Gerard and Erik in the next few pages.

We hope that you will find the latest MAE news exciting. Please visit our webpage at: https://wmich.edu/mechanical-aerospace/ and view our latest department video. If it’s been a while since you visited us, please contact us and arrange to visit our department.

Koorosh Naghshineh, Ph.D., P.E.
Chair, Department of Mechanical and Aerospace Engineering
During spring semester 2019, Dr. Asher obtained a grant from the Michigan Department of Transportation (MDOT) as part of the Michigan Mobility Challenge. The award was part of a collaboration with multiple companies and universities; Pratt & Miller Engineering (Lead), Robotics Research, Comet Mobility, Western Michigan University, University of Michigan, Kevadiya, and Easterseals. The project is very fast paced, it officially began in March 2019 and will conclude in December 2019. The goal of this project is to introduce a low speed fully electric self-driving shuttle transportation solution for persons with disabilities.

WMU’s contribution to the project is the modeling and evaluation of the electric self-driving shuttle that will be implemented at the Veterans Hospital. Western is also helping with comprehensive analysis and service benefits that the shuttle will provide to the facility. The shuttle was provided by Devpod and modified by Pratt & Miller Engineering to accommodate the ambulatory and visually disabled veterans. This shuttle will be able to help disabled veterans get to their appointments for longer operational periods than the existing shuttle. This shuttle also reduces the operational cost of transportation and reduces overall combustion emissions at the facility.

WMU has made models and simulations for cost analysis for this new system which can be used for large campus deployments. A high-fidelity electric vehicle model was developed in Autonomie with custom drive cycles. Our team is also developing rigorous test plans that considers the latest autonomous vehicles sensing and technology to improve future projects with self-driving shuttles. A 3D visualization of potential campus deployments which includes interaction with the city of battle creeks transportation will help show how this technology helps persons with no transportation of their own. Lastly, WMU was chosen for a 2 week pilot demonstration of the technology which occurred from October 21st to November 1st.

This project has enabled WMU to become more involved in self-driving and electric vehicle research and establish new connections with the automotive industry. Additionally, this project helps realize two goals:

1. teaching students the latest trends in the automotive industry so they can be competitive in the job market; and
2. providing high-quality engineering research to local companies.

WMU’s Auto Lab has undergone significant changes including new leadership, a new research focus, and a new layout. Faculty with active research projects in the Auto Lab now includes Dr. Claudia Fajardo-Hansford, Dr. Richard Meyer, and Dr. Zachary D. Asher. The research focus has been expanded to include new trends in the automotive industry such as electric and self-driving vehicles. To support this effort, old equipment was removed and new equipment set-up.

The Auto Lab’s “spring cleaning” resulted in a more organized workspace with room for graduate student desks. New equipment includes five high-performance computers with dual-screen monitors, a self-driving vehicle computer (NVIDIA DRIVE PX2), a large TV screen and phone to host conference calls, mobile workstations to support work next to vehicles, and a 2019 Kia Niro that is drivable with an Xbox controller. Other planned updates include new paint, posters describing active research projects for tours, and a big Western “W” on the Kia Niro. Removed equipment includes an old Hunter flat alignment lift, a Sun 670 Alternator Tester, a nonfunctioning Horiba Emission Analyzer, starters, alternators, miscellaneous old automotive parts, as well as removal of more than 35 powertrains, drivetrains, and drivelines. Glassware and various supplies have been repurposed at the chemistry department. Lastly, Bosch donated a fluids analysis machine to replace the older one that was in the lab.

Overall, these changes support new automotive research projects such as self-driving controls, vehicle electrification, fuel efficiency, and system-level analysis. Dr. Asher’s grants from the Michigan Mobility Challenge Project and the U.S. Department of Energy have been utilizing the newly renovated space. The renovations allow collaborations with other WMU departments such as computer science and electrical engineering. Auto Lab faculty are planning many more new and exciting projects to expand the lab’s capabilities and provide more opportunities for students. We seek to realize the future of automotive engineering here at Western Michigan University.
Erik Pederson

B.S. AERONAUTICAL ENGINEERING ’99,
M.S. MECHANICAL ENGINEERING ’01,
PH.D. MECHANICAL ENGINEERING ’03

After graduating from Western Michigan University, Erik Pederson ran his own consulting business for five years where he worked with many different companies including Parker, Williams International, Cirrus, Kelly Aerospace, and Cessna. In 2007, Pederson joined Kelly Aerospace Thermal Systems in Cleveland, Ohio as Vice President of Engineering and General Manager. In 2012, he joined Woodward Turbine Combustion Systems in Zeeland, Michigan Engineering Manager and where he’s taken on roles of increased responsibility. Currently, Pederson serves as Vice President and General Manager for Woodward Turbine Combustion Systems. Pederson is married to his high school sweetheart, Lisa. They have three children and return often to the WMU campus for hockey and football events.

Favorite Bronco Memory: Hopefully I can share two. The memory I think about often is flying the Flight Test Aircraft with Art Hoadley for the Flight Test Engineering Class as well as working to setup the Wind Tunnel Facility at the Kalamazoo Airport. Another fond memory (the building no longer exists) is the fun times many of us engineers had at Knollwood Tavern.

Gerard Devito

B.S. MECHANICAL ENGINEERING ’88

Gerard DeVito served Eaton Corporation in a variety of roles beginning in 1987 until his recent retirement. DeVito, who most recently was Vice President of Technology, Vehicle Group, began his career with Eaton as a Development Engineer. Prior to his last position with the Vehicle Group, DeVito served as Executive Director, Next Generation Automated Transmission Platform Team. DeVito’s 31-year tenure at Eaton also included roles of increasing responsibility in product design engineering, application engineering, product planning, product strategy, and sales and marketing. DeVito was responsible for global technical development of Eaton’s vehicle group products. In addition, he focused on building organizational capability in the company’s technology and engineering functions. He holds two patents.

Favorite Bronco memory: The snow storm of 1985, two snow days and lots of winter fun.
For Anand Sankey, the journey from Sunway University in Malaysia to success in the United States started with a long layover at Western Michigan University's catering services department.

Upon arrival in Kalamazoo in December 1994 to study mechanical engineering at WMU’s College of Engineering and Applied Sciences, Sankey found a job setting up, serving at, and tearing down University events. Through this job, Sankey got to know then-President Diether H. Haenicke and other University leaders. After receiving his Bachelor of Science in mechanical engineering degree in the spring of 1996, Sankey was still working for catering services while looking for a full-time engineering position. Haenicke asked about his job search. When hearing it was ongoing, Haenicke asked Sankey if he’d be interested in working for the University and, if so, there was an opening for a mechanical engineer in the University’s facilities management department.

That conversation was the beginning of a career that’s spanned more than two decades. “I was looking at positions all over the United States,” Sankey says. “Dr. Haenicke’s question opened my eyes to the job possibilities that were right in front of me.”

On November 3, 1997, Sankey began his first full-time position with Western as a prevention maintenance scheduler for the facilities management department. He has since worked his way up through the ranks. First, to the role of mechanical project manager and then to Assistant Director for energy before assuming his current position as Director of Maintenance Services.

Recently, Sankey was honored with the Distinguished Alumni Award by the College of Engineering and Applied Sciences at the University’s annual Night of Excellence. The college recognized Sankey for his outstanding work for the University and contributions to the college. “Anand’s leadership in facilities management has been instrumental in keeping our college’s home, Floyd Hall, in exceptional condition,” says Steve Butt, the college's interim dean. “He’s giving back as an alumnus by taking care of our current students, faculty and staff by making sure our facility stays in top shape.”

A career as a mechanical engineer wasn’t always Sankey’s goal: from a young age, he wanted to be a pilot. “The pilot thing didn’t work out, so I started looking for my next step in my higher education journey. Somewhere I heard about mechanical engineering and decided that sounded interesting.” While the idea of being a mechanical engineer was new to Sankey, the idea of studying abroad was not because his brother was attending a university in England. “My brother suggested I go somewhere other than England, so he could come visit me.”

Sankey decided he would study in the United States. He selected Sunway University and WMU because of the universities’ joint program, which made it easy for students to transfer to WMU after their general studies in Malaysia were complete. It took Sankey just 18 months to complete enough credits to transfer to Western Michigan University.

His transition to WMU was smooth, Sankey says, because older students from Malaysia provided mentoring on everything from where to buy groceries to how to get a driver’s license. Michigan was a bit of a surprise, though.

“When I decided to study in the U.S., I didn’t know where Michigan was or anything about it,” Sankey says, explaining that his exposure to the States was through TV shows centering around California. Michigan, he says, was much different than scenes he’d seen of warm California. But, he enjoyed his first winter in Kalamazoo, calling it “refreshing.”

Now, Sankey is firmly rooted in the WMU and Kalamazoo communities, is married to Kalamazoo-native Jennifer, and father to a teenage daughter. He’s also giving back to the University that welcomed him 25 years ago by mentoring students.

Sankey found his first professional position challenging at times because he didn’t have hands-on experience. He found the mentorship provided to him by older facilities management coworkers invaluable and wants to help current students get a leg up before they graduate. So, he hires interns and student employees regularly.

“I want to provide a hands-on experience for students,” Sankey says. “My intention is to help as many students as possible, to give them an opportunity.”
Luis Silva (Bachelor of Science in Mechanical Engineering '17, Master of Science in Mechanical Engineering candidate, Ph.D. pre-candidate) was awarded a NASA Space Technology Research Fellowship on the topic of multiscale multiphysics and multi-fidelity simulation. Metal additive manufacturing processes such as selective laser sintering and selective laser melting have many advantages over conventional manufacturing processes. However, one disadvantage with additive manufacturing can be the introduction of large residual stresses. These stresses are formed as a result of the large temperature gradients in the parts, which are themselves due to the localized (laser) heat source. Although residual stresses can be beneficial (such as compressive stresses aiding in crack closure), large residual stresses frequently lead to part warping and an effective weakening of the overall structure.

The goals of the research fellowship include optimization of the residual stresses and their distribution. Topology optimization processes will be used in combination with residual stress modeling to determine optimal as designed and as-printed geometry meeting functional requirements. The novel techniques under investigation require multiscale, multi-fidelity, and multiphysics simulation for an accurate prediction of residual stresses within reasonable time frames. The models will include printing and subsequent operational loads.

Dr. Peter Gustafson and Silva traveled to Glenn Research Center in Cleveland, Ohio in August for a week-long project kick-off. There they met with Drs. Evan Pineda and Brett Bednarcyk who will serve as the Research Collaborators at Glenn. Pineda and Bednarcyk are both technical experts in multiscale modeling and are two of the principal authors of the NASA NASMAT multiscale analysis code that will be used prominently in the research.

There were several opportunities during the week to attend technical presentations on a variety of topics in aerospace materials and structures. Tours of the available facilities allowed for the exploration of potentially useful tools as well as the opportunity to meet potential collaborators. Additional educational tours included Glenn’s Plum Brook Station, which houses the world’s largest space simulation vacuum chamber. Also, the tour of Glenn’s impact lab showed how materials and structures are tested for high-speed collisions. A tour of the Simulated Lunar Operations Laboratory described how shape memory alloys will be used in the next generation of space tires for roving surface vehicles.

Beyond the numerous technical opportunities, Silva and Gustafson networked with future collaborators, mentors, and friends. A highlight was a trip to a Cleveland Indians baseball game where Gustafson was surprised to learn that several of the attending NASA summer students (including Silva) were witnessing their first baseball game. This provided new opportunities for teaching and learning outside the classroom. In the last event of the week, Silva and Gustafson played in the weekly intramural soccer game against NASA researchers and summer students. In this context, Silva took the role of mentor while Gustafson was schooled.
The College of Engineering and Applied Sciences took six current and former members of the American Institute of Aeronautics and Astronautics (AIAA) Pegasus Chapter to the Experimental Aircraft Association (EAA) Airventure in Oshkosh, Wisconsin, to help recruit new engineering students. I was fortunate to attend for the second year in a row and was able to promote the college and enjoy the festivities. We brought the rocket and aircraft that we designed, built, and competed with during the 2018-2019 school year in order to showcase the opportunities provided by the Mechanical and Aerospace Engineering Department to prospective students and other Airventure attendees.

We met many people during our time at Oshkosh! Our table was located in the same tent as Western Michigan University’s aviation program, so we met current WMU students that usually spend their time on a different campus. It was an amazing experience to be able to meet many WMU and CEAS alumni that stopped by the tent to say hello and check out the lanyards and shirts we were distributing. We also had the opportunity to network with employers from aerospace companies such as Cirrus Aircraft, Regional Airlines, and NASA.

When we were not busy representing WMU, we were able to experience many of the highlights of the festival. We all saw multiple airshows, listened to various aerospace speakers, and were able to walk through the inside of a Boeing 747 and a Lockheed C-5 Galaxy. A special highlight was watching Ashleigh Heath, a WMU aerospace student and member of our AIAA team, perform with her RC airplane. It was an excellent trip and a great time to be a Bronco in aerospace!

-Grace Dybing, Aerospace Engineering Student and President of AIAA
Parker-Hannifin Donates New Hydraulic Trainers

College of Engineering and Applied Sciences students have new hands-on educational opportunities thanks to Parker-Hannifin. The company is donating two new industrial-grade modular hydraulic trainers to the Parker-Hannifin Motion and Control Laboratory in Floyd Hall, doubling the number of trainers available. The modular nature of the trainers adds a new dimension to the educational experience: much like using toy building blocks, students will have the freedom to construct hydraulic circuits from a blank slate to meet real-world requirements.

Also coming to the lab courtesy of Parker are four digital pressure gauges and two flow meters that allow students to work with instrumentation they could expect to use in their careers. In addition, Parker is donating two electrohydraulic servo/proportional valve and cylinder modules that bring together the electronics and hydraulics needed to investigate automatic control of hydraulic systems. Students will be able to perform electrohydraulic control experiments that span velocity, pressure, and force.

The Parker-Hannifin Motion and Control Laboratory was made possible by a generous $100,000 grant in 2003. The lab promotes scholarship in the tri-technologies of hydraulics, pneumatics and electro-mechanics.
Dr. Kristina Lemmer

Dr. Kristina Lemmer participated in the Air Force Research Laboratory (AFRL) Summer Faculty Fellowship Program at Wright Patterson Air Force Base in Dayton, Ohio this past summer where she researched nanosecond pulsed discharges for use in hypersonic combustion. Partnering with the Electrical Systems Branch of the Aerospace Systems Directorate at AFRL, she performed Thomson scattering experiments on a pin-to-pin air gap, nanosecond pulsed discharge. Thomson scattering is a method by which a laser is passed through the discharge. When the laser interacts with the plasma in the discharge, light is scattered. That light is measured, and from the spectral response, electron density and temperature can be determined. This work is vital for understanding how a pulsed plasma discharge system can improve efficiency and decrease ignition time and temperature in hypersonic combustion systems. Recent MAE graduate Jacob Russell (BSAE ’19) joined Dr. Lemmer for this opportunity.
My semester-long sabbatical took me to the Far East. I visited two countries, Taiwan and Japan. I stayed for a total of three weeks in Japan. There, I worked with a research collaborator, Dr. Shinya Yamada, a neurosurgeon, and met with many of his esteemed colleagues. Dr. Yamada and I have been collaborating on research related to the functioning of the fluids in the human brain.

Tokyo is a magnificent metropolitan area connected by webs of countless lines of subways, trains, and buses (I got lost a couple of times, it goes without saying). I also attended a computational biomedical engineering conference in Sendai, Japan, another beautiful city north of Tokyo with great many trees and plants.

In Taiwan, the weather was pleasant. My wife and I were spoiled by our relatives with great food and lots of hospitality. I gave a seminar lecture in the National Taiwan Ocean University on how human cardiovascular circulations might be affected by the space environment in the absence of gravity and a second seminar in the Aerospace Engineering Department in Tamkang University in Tamsui at the northwest corner of Taiwan. Tamsui, being an important seaport in the early days of trades, is dotted with many places of historical significance. I could not resist sharing a photo of the original classroom building of the Oxford College in 1882 (now a part of Aletheia University), naturally in the year 2019.
Aviation has played a major role in our quality of life and economic prosperity. The air transportation industry carries about 40% of the value of all world trade. It also allows us to safely and quickly travel around the globe, practically making the world a village. However, combustion-based gas turbine engine propulsion currently used in aircraft transport, similar to the internal combustion engine in automobiles, produces emissions that impact the environment. Concerns for the environmental impacts, therefore, are driving the future development of fuel-efficient turbine engine and electric propulsion. Three new teaching tools were recently deployed in the Aerospace Engineering 4660 Aerospace Propulsion I course to help aerospace engineering students adapt to the ever-changing demands on aerial vehicles.

Newly designed and built from scratch by a faculty/student team in-house with extensive use of 3D printing, the portable electric ducted fan (EDF) lab platform provides our students a convenient tool to learn electric propulsion systems. The experiential learning comes through hands-on operation and testing of the electric-motor fan in producing thrust and the associated efficiencies in the processes of energy conversions. The new portable EDF lab platform is believed to be the first-of-its-kind. The platform labs can be conducted in a regular classroom or in a dedicated facility, thus portable and mobile. The EDF lab is uniquely suited for teaching and learning of aircraft electric propulsion. The lab and the associated new teaching materials for aircraft electric propulsion are included in the course.

The team used 3D printing to make a cutaway turbofan engine that is 18-inches long with an eight-inch diameter fan. A portion of the exterior casing of the turbofan engine is removed, which reveals the working components of the model turbofan engine. The two spools of the compressor/turbine coupling rotate freely, giving the students taking the course a dynamic experience of the functional relationship of the engine and another hands-on tool to learn aircraft propulsion.

The third tool we have developed is machined out of a mini gas turbojet engine. A portion of the metal outside housing, including the nozzle, is removed, exposing the combustor of the engine. A motor powered by a single AA battery spins the compressor rotor and the turbine rotor on either side of the combustor at low speed. The spinning compressor/turbine rotors can be stopped by the touch of a fingertip, allowing students to safely learn the inner workings of turbine engine combustion.

The faculty on the team is Dr. William W. Liou, professor of Aerospace Engineering. David Salazar, a graduate student in Aerospace Engineering, who is passionate about flight, works diligently in the development of new teaching tools. The team acknowledges the support of the 3D printing services provided by the Computer Labs in the Office of Information Technology at Western Michigan University.
Most faculty members hold terminal degrees in mechanical engineering, aerospace engineering or closely related fields. Their areas of research include but are not limited to mechanical system, structural dynamics, system design and controls, advanced materials, experimental stress analysis, vehicle dynamics, electric propulsion, experimental and computational fluid dynamics, thermal and power systems, fuel cells, noise and vibrations, finite element analysis, and micro and nano-technology.

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